
Testing The Effectiveness of Using a Board Game on English Vocabulary in Biology Learning for Review and Evaluation to Improve Student Performance

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Article Info

Article history:

Received: December 17th, 2025

Revised: June 29th, 2026

Accepted: July 16th, 2026

Available online: July 31st, 2026

<https://doi.org/10.33541/edumatsains.v11i1.7687>

Abstract

This study investigates the effectiveness of an IGCSE Biology board game as an alternative learning tool to address limited digital access, enhance students' understanding of English biological vocabulary, encourage social interaction, and improve learning performance. Using a quantitative approach with a true experimental pretest posttest control group design, the research involved 80 eighth-grade students at Aichurok Bishkek High School, Kyrgyzstan. Sixty students participated in the experimental group, while 20 students formed the control group. The study was conducted between April and May 2025. Data were analyzed using Microsoft Excel and SPSS, applying statistical tests such as normality, homogeneity, Wilcoxon Signed Rank, Mann Whitney U, correlation, and reliability analyses. The results demonstrate that the board game significantly enhanced students' vocabulary mastery, engagement, communication, and conceptual understanding. A statistically significant difference was found between the post-test scores of the experimental and control groups (Asymp. Sig. = 0.000). Reliability analysis showed excellent consistency for the board game instrument and student engagement, while collaboration and communication indicators were moderately reliable. Teacher observations also revealed continuous improvement across instructional cycles. Overall, the findings indicate that the IGCSE Biology board game is an effective and engaging learning medium that supports academic achievement and the development of 21st-century skills. Further studies with larger samples and longer implementation periods are suggested to explore its long-term effectiveness.

Keywords: Board Game Effectiveness, English Vocabulary, Vocabulary Review

1. Introduction

International curricula such as the Cambridge Curriculum require students to actively use English not only for communication but also to understand subject content, including Biology. At Bishkek Aichurok High School, varying levels of English proficiency within the same class hinder students' comprehension of Biology, which relies heavily on specific scientific vocabulary. This challenge is reflected in the low number of students ready for the IGCSE Biology examination in 2023 and 2024, indicating that limited mastery of English

biological terminology remains a major barrier to academic performance and assessment readiness.

Digitalization has significantly transformed learning processes by shifting instruction from teacher-centered to student-centered approaches, requiring teachers to integrate technology meaningfully into pedagogy (Wahyudi, 2019). While digital tools are effective for vocabulary review because they allow flexible and self-paced learning, their use is restricted at Bishkek Aichurok High School due to its boarding school policy that limits gadget usage. This condition necessitates alternative learning media that remain interactive without relying on high-level digital technology.

Educational games, particularly board games, offer an interactive and socially engaging learning medium. Board games emphasize collaboration, communication, and critical thinking while also providing cognitive and emotional benefits (Booth, 2021). In response to the lack of IGCSE Biology-specific learning games, this study developed a Biology vocabulary board game adapted from Monopoly. The game incorporates graded vocabulary difficulty, point-based cards, and challenge elements, encouraging repeated exposure to terminology while fostering peer interaction and motivation during learning activities.

Board games function effectively as tools for review and evaluation by promoting self-correction and peer correction through repeated listening, speaking, and reading of vocabulary. Mastery of English biological terminology is essential for understanding complex concepts and successfully answering IGCSE Biology exam questions. Given the limited readiness of students to take the exam despite its significant academic and scholarship benefits, the use of board games serves as a practical, independent, and engaging strategy to strengthen vocabulary acquisition, support active learning, and improve students' preparedness for international Biology assessments.

2. Methods

This study employed a quantitative experimental method using a true experimental design with a pretest posttest control group design. The participants were 80 eighth-grade students at Aichurok Bishkek High School, Kyrgyzstan, consisting of 60 students in the experimental group and 20 students in the control group. The research was conducted from April to May 2025. Data were collected through pretests and posttests to measure vocabulary improvement, teacher observations focusing on gameplay duration, student engagement, communication, cooperation, vocabulary use, and comprehension, as well as student feedback regarding their learning experiences with the board game.

The research instruments included vocabulary tests, observation sheets and rubrics, and student feedback forms. Instrument validity was established through content and construct validity evaluated by subject-matter experts, while reliability was tested using Cronbach's Alpha (Yusup, 2018). Data analysis involved prerequisite tests of normality and homogeneity; since these assumptions were not met, non-parametric analyses were applied, including the Mann-Whitney U test and the Wilcoxon Signed Rank Test. Additional analyses included mean score calculations, Pearson correlation for feedback items, and reliability testing using Microsoft Excel and SPSS, with the overall aim of evaluating the effectiveness of the board game in improving students' English vocabulary in Biology.

3. Result and Discussion

3.1 Results

Hypothesis Testing of Differences Between the Control Group and the Experimental Group

To determine the comparison between the control group and the experimental group as shown in the results of non parametric analysis, particularly the Mann Whitney U test (commonly used to compare two independent groups, in this case the control group and the experimental group), both for the pre-test and post-test. The following is an explanation of each part of the table:

Table 1. Results of Comparison of Mean Ranks Between Groups in the Pre-Test and Post-Test

<i>Ranks</i>				
Test	Group	N	Mean Rank	Sum of Ranks
Pre-Test (%)	Control	23	42.65	981.00
	Experimental	62	43.13	2674.00
	Total	85		
Post-Test (%)	Control	23	14.72	338.50
	Experimental	62	53.49	3316.50
	Total	85		

The post test results show that the experimental group obtained a mean rank of 53.49, which is much higher than the control group, which only achieved a mean rank of 14.72. This difference indicates a significant improvement in the experimental group after the treatment was administered.

Table 2. Results of the Mann–Whitney U Test and Wilcoxon W Test

<i>Test Statistics^a</i>		
	Pre-Test (%)	Post-Test (%)
Mann–Whitney U	705.000	62.500
Wilcoxon W	981.000	338.500
Z	-0.080	-6.460
Asymp. Sig. (2-tailed)	0.937	0.000

a. Grouping Variable: Group

Based on the analysis using the non-parametric Mann–Whitney U test, the significance value (Asymp. Sig. 2-tailed) for the pre-test data was 0.937. This value is far above the significance level of 0.05, indicating that there was no significant difference between the control group and the experimental group before the treatment was given. In contrast, the post-test analysis showed a significance value of 0.000, which is far below 0.05, indicating a very significant difference between the control group and the experimental group after the treatment was administered.

Hypothesis Testing of Differences Between Pre-Test and Post-Test in the Control Group

Statistical testing was conducted to compare pre-test and post-test results in both the control group and the experimental group. The purpose of this test was to examine the extent to which the intervention or treatment namely the use of the IGCSE Biology board game affected the improvement of students' learning outcomes. The analysis was conducted separately for each group to identify changes in scores before and after the treatment. Thus, this test provides a more detailed picture of the effectiveness of the treatment and allows the researcher to assess whether the observed changes were statistically significant. The results of this test then serve as the basis for drawing conclusions regarding the effectiveness of the learning method applied to each group.

Table 3. Results of the Wilcoxon Signed Rank Test Between Pre-Test and Post-Test in the Experimental Group

		Ranks		
		N	Mean Rank	Sum of Ranks
Post Test (%) - Pre Test (%)	Negative Ranks	1 ^a	2,00	2,00
	Positive Ranks	58 ^b	30,48	1768,00
	Ties	3 ^c		
	Total	62		

a. Post Test (%) < Pre Test (%)

b. Post Test (%) > Pre Test (%)

c. Post Test (%) = Pre Test (%)

The table presented shows the results of the Wilcoxon Signed Rank Test, which was used to analyze differences between pre-test and post-test scores in the experimental group. This analysis is appropriate because the data were not normally distributed and aimed to determine whether there was a significant change before and after the treatment within the same group. The results of the Wilcoxon Signed Rank Test in the experimental group indicate that most students experienced a significant increase in scores after being given the treatment in the form of the IGCSE Biology board game. Of the 62 students, 58 showed an increase in post-test scores compared to the pre-test, only 1 student experienced a decrease, and 3 students had the same score. This indicates that the use of interactive game-based learning media was able to have a positive effect on student learning outcomes. The dominant increase in post-test scores compared to pre-test scores demonstrates the effectiveness of the treatment in improving students' understanding and academic achievement in the material taught. These findings strengthen the evidence

that innovative learning approaches can promote higher engagement and better learning outcomes than conventional approaches.

Table 4. Results of the Wilcoxon Signed Rank Test in the Experimental Group (Post-Test and Pre-Test)

Test Statistics^a	
	Post Test (%) - Pre Test (%)
Z	-6,674 ^b
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Based on the significance value of Asymp. Sig. (2-tailed) of 0.000 (< 0.05), it can be concluded that there is a very significant difference between pre-test and post-test results in the experimental group after the treatment in the form of the IGCSE Biology board game was administered. The negative Z value (-6.674) also indicates that most students experienced an increase in scores on the post-test compared to the pre-test.

Effectiveness of the Board Game

Based on the analysis results, the use of board games in IGCSE Biology learning aimed at vocabulary review demonstrated improvements in learning outcomes, high student engagement, and positive perceptions of the learning media.

Table 5. Summary of Pre-Test and Post-Test Results for the Control and Experimental Groups

Mean Rank Mann–Whitney U	
	Pre-Test
Control Group	42.65
Experimental Group	43.13
Control & Experimental Groups	
Asymp. Sig. (2-tailed)	0.937

The analysis results in the table show that the mean rank pre-test scores of the control and experimental groups did not differ significantly. The significance value (Asymp. Sig. 2-tailed) of 0.937, which is far above the 0.05 significance threshold, reinforces the conclusion that the initial abilities of both groups were comparable. This condition ensures that the differences observed in the post test results were not caused by differences in initial ability, but rather by the treatment provided. In the post-test phase, the experimental group showed higher improvement compared to the control group. This difference indicates that the intervention using the IGCSE Biology board game was effective in improving students' vocabulary understanding.

Table 6. Summary of Student Survey Reliability Test Results

Aspect	Reliability Score
Board Game	0.860
Collaboration and Communication	0.617
Engagement	0.855

The survey instruments used in this study covered three main aspects: perceptions of the board game, collaboration and communication, and student engagement. All three aspects were measured using Likert-scale-based questionnaires. Based on the reliability analysis, the Cronbach's Alpha values obtained were 0.860 for the board game aspect, 0.617 for collaboration and communication, and 0.855 for student engagement. Reliability values of 0.860 and 0.855 indicate very good internal consistency according to the guidelines of George and Mallery (2003), values above 0.80 fall into the "good" to "cellent" category. This indicates that the items in these two aspects are consistently interrelated and capable of measuring the intended constructs reliably. Meanwhile, the reliability value for collaboration and communication of 0.617 falls into the "questionable" category based on the same interpretation scale.

In addition to student participation in completing surveys across the three aspects, the learning process was also accompanied by direct teacher observation of the gameplay. This observation was conducted by assessing five aspects using a rubric with a scale of 1 to 5. The results of the assessment of these five aspects over three game cycles are summarized in the following table.

Table 7. Summary of Teacher Observations During Gameplay

Categories	Average Score
	1st Cycle
Engagement	3
Vocabulary Use	3
Communication	4
Collaboration	4
Comprehension	4

The analysis of teacher observations across the five student skill aspects shows a consistent upward trend from the first to the third cycle. This explicitly demonstrates that students' abilities developed alongside the frequency of their interactions in the game, indicating the effectiveness of this game-based learning medium. This finding is further supported by data on game duration, which increased from an average of 16 minutes in the first cycle to 25 minutes in the second cycle and reached 30 minutes in the third cycle. The increasing duration indicates that students became more engaged and comfortable with the activity, reflecting higher levels of participation intensity and social interaction.

3.2 Discussion

This study developed and implemented an IGCSE Biology board game as an innovative learning medium to strengthen students' mastery of English biological

vocabulary. Adapted from familiar board game models such as Monopoly, the game was designed to be both engaging and educational, enabling students to review and apply technical biology terminology commonly found in the IGCSE curriculum. Played in small groups, the board game also fostered social interaction, communication, and collaboration, while serving a diagnostic and formative function to identify students' readiness for the demands of IGCSE Biology learning.

The effectiveness of the board game was evaluated through a comprehensive process that included material validation by biology experts, classroom observations, pre-test and post-test assessments, and student feedback. Observations focused on gameplay duration, engagement, motivation, communication, cooperation, vocabulary use, and comprehension. Repeated gameplay led to increased familiarity with the rules, higher engagement, and longer play duration, supporting the view that sustained involvement facilitates learning and information processing (Chin & Zakaria, 2015). These findings indicate that the board game created a supportive cognitive and emotional learning environment for vocabulary acquisition.

Results from observational data and assessments showed notable improvements in students' vocabulary use, communication skills, collaboration, and comprehension over successive game rounds. Students actively used biological terms in meaningful contexts, engaged in peer learning, and demonstrated growing confidence and understanding. Statistical analysis using Mann Whitney U and within-group comparisons confirmed that while both control and experimental groups started at comparable levels, the experimental group showed significantly greater post-test gains. This provides strong evidence that the IGCSE Biology board game was more effective than conventional review methods in improving vocabulary learning outcomes.

Student feedback indicated high levels of satisfaction, engagement, collaboration, and communication, supported by instruments with acceptable validity and reliability (Tavakol & Dennick, 2011). These findings align with game-based learning theories emphasizing motivation, engagement, and knowledge retention through meaningful play (Prensky, 2001; Gee, 2007). Moreover, recent studies highlight the importance of sufficient gameplay duration and analog board games in enhancing motivation and learning processes (Alotaibi, 2024; Sousa et al., 2023). Overall, the results demonstrate that the IGCSE Biology board game is an effective, engaging, and sustainable strategy for reviewing vocabulary, strengthening communication skills, and supporting students' readiness for international science curricula.

4. Conclusion

This study demonstrates that the IGCSE Biology board game is an effective supportive medium for reviewing and evaluating English biological vocabulary, particularly in schools with limited digital access. Statistical results showed a significant difference in post-test scores between the experimental and control groups (Asymp. Sig. = 0.000), indicating a clear improvement in students' vocabulary mastery. The board game also enhanced student engagement, communication, collaboration, and comprehension, as reflected in increasing observation scores and longer gameplay duration across sessions. Survey instruments for the board game and student engagement showed very good reliability ($\alpha > 0.85$), while

collaboration and communication instruments require further refinement. Despite limitations related to sample size and intervention duration, the findings suggest that the board game has strong potential as an innovative science learning strategy that supports vocabulary development and fosters 21st-century skills in an engaging learning environment.

5. Acknowledgments

The author would like to express sincere gratitude to all parties who contributed to the completion of this study. The author is also grateful to the subject matter experts and validators for their valuable insights and constructive feedback that improved the quality of the learning media and research instruments. Appreciation is further conveyed to colleagues and mentors who provided guidance, support, and encouragement throughout the study. Finally, the author thanks all individuals whose contributions, directly or indirectly, made this research possible.

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